"COILING DEVICE AND METHOD FOR ROLLED OR DRAWN LONG PRODUCTS"

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FIELD OF THE INVENTION

The present invention concerns a coiling device and the relative method for long metal products, ferrous or not, as obtained from drawing or rolling operations, whether done hot or cold. To be more exact, the invention concerns the coiling of wire, bars, flat strips, rods (smooth or ribbed), or tubes, having a transverse section that is round, square, rectangular, hexagonal or otherwise, of various sizes.

To be more exact, the invention concerns the device to guide and contain the coiled product, on the winding mandrel, in order to contain it laterally and to impose on the forming coil the desired external form. The winding mandrel may have a horizontal, vertical or inclined axis of rotation.

The invention is applied to coiling machines with cantilevered axis.

BACKGROUND OF THE INVENTION

In the state of the art, the problems connected to coiling, on a continuously rotating mandrel, a long metal product, either rolled or drawn, traveling at high speed, to be wound in contiguous, adjacent and superimposed spirals, in a uniform manner, so as to form very compact coils, are known.

It is known that the operation to form the coil, so that the spirals are compact and uniformly distributed in every layer and for the whole longitudinal extension of the coil, is very delicate.

The problem of easily removing the finished coils from the mandrel is also known.

If the operation to remove the coil is not carried out correctly, defects may occur in the finished coils, such as for example the wound spirals may be released and/or the coiled roll may have a bad aesthetic appearance. Moreover, if the coil does not have a regular geometry, there are problems of stacking during the storage step, and also problems with installing the coil on the machine which uses the same, and problems with the correct unwinding of the coiled product.

The European patent EP-B-1.126.934 discloses a coiling machine which comprises suitable guides, substantially semi-cylindrical in shape, otherwise known as flaps or insertion blades. Said guides are able to intercept the metal product to be wound, as it arrives from the rolling mill or the drawing machine, and are able to facilitate the formation of the first spirals of the coil on the mandrel. This known coiling machine, which has the axis of the mandrel cantilevered, also comprises a mobile containing plate to frontally contain the coil, which plate cooperates with the terminal, cantilevered part of the mandrel, and which can be arranged in the following two limit positions: a first position for the formation of the coil, wherein the containing plate is orthogonal to the axis of the mandrel and coaxial therewith, and a second position wherein the containing plate is rotated by about 90° and arranged substantially parallel to the axis of the mandrel, in a position of non-interference with the path on which the finished coil is discharged.

Before starting to distribute the spirals on the mandrel, it is necessary that the metal product to be wound is correctly gripped on the mandrel itself; to this purpose, it is necessary to provide a device that performs the clamping of the metal product to the mandrel with great

reliability, precision and repeatability.

The US Patent US-A-3,592,399 discloses an apparatus to grip and wind the leading end, or head, of a rolled product onto a mandrel, rotating around a horizontal axis, which is provided with a first containing plate to contain the coil to be formed, arranged perpendicular to the mandrel, and a second containing plate to contain the coil laterally. This second plate is autonomous and movable with respect to the mandrel between an operating position, wherein it is parallel to the first plate, and an extraction position, wherein it is arranged distant from the mandrel and rotated laterally by 90° with respect thereto. To be more exact, the second plate is mounted rotatable on a cylindrical supporting element, which in turn can rotate on a vertical support. In order to facilitate the beginning of the formation of the coil, the second containing plate has an axis of rotation which does not coincide with that of the mandrel and is provided with an annular groove which has a circular surface eccentric with respect to the outer surface of the mandrel. Due to the misalignment of the second containing plate and the mandrel, the two surfaces form a clamping channel with a variable section, into which the leading end of the rolled product to be wound enters and is locked. Moreover, in order to facilitate the clamping of the head at the start of the winding operation, the apparatus comprises a guide element, substantially semi-circular in shape, which in the operating position cooperates with the aforesaid clamping channel until the first spirals have been wound onto the mandrel. After some spirals have been formed, the guide element is distanced from the mandrel and raised to an inactive position. This known apparatus does not allow to obtain a clamping of the leading end which is repeatable and reliable. If clamping

does not occur, then we have a relative sliding between the product and the mandrel, so that coiling cannot begin. On the other hand, if the leading end of the rolled product becomes detached from the clamping channel, after the formation of a few spirals (with the mandrel under torque and the rolled product already flowing), the tension of the spirals is released, there is a consequent slippage between the parts and hence a blockage is created upstream of the coiling device, with all the problems that derive from this. Such a detachment during the coiling step is also facilitated by the progressive cooling of the rolled product which begins to shorten as it shrinks, starting from the leading end, thus causing a drawing effect that causes the leading end to come out of the gripping channel.

It is therefore of fundamental importance to be able to guarantee a secure and long-lasting clamping of the initial segment of the rolled product on the mandrel.

One purpose of the present invention is to achieve a coiling device for long metal products which will guarantee a considerable rapidity in installing the mobile frontal containing means that cooperate with the end part of the mandrel.

Another purpose of the invention is to guarantee the correct performance of the coiling process.

Another purpose pursued by the device according to the invention is to improve the quality of the final coil in terms of winding, compactness, density and holding capacity of the spirals.

A further purpose of the invention is to prevent damage and a reduced quality of the product.

It is also a purpose of the invention to simplify maintenance operations on said device.

The advantages achieved give a coil having a desired

geometric profile which allows to exploit the storage space, also in height, to optimize the handling and transport steps, and gives a better functioning to the user machines, which can thus work at greater speed.

Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

The present invention is set forth and characterized in the main claims, while the dependent claims describe other characteristics of the present invention or variants to the main inventive idea.

In accordance with the above purposes, a coiling device for long products, whether they be rolled or drawn, according to the present invention is provided with a guide and containing device which has the characteristics as in claim 1.

The purposes are achieved also by means of a coiling method for the long metal product which has the characteristics of claim 17.

The device and method according to the present invention are applied to machines for coiling long metal products, obtained from rolling or drawing operations, whether performed hot or cold. The products can be irrespectively wire, bars, flat strips, rods (smooth or ribbed), tubes, both of ferrous material such as steels with low, medium or high carbon content, stainless steels, alloyed or other, and also non-ferrous material, such as aluminum, copper or other. The invention is applied to coiling machines or reeling machines which have a mandrel with a cantilevered axis.

Said long metal products can have any transverse section whatsoever, that is, round, square, rectangular, hexagonal

or otherwise, particularly, but not restrictively, with diameters between 8 mm and 52 mm or, in the case of bars or flat strips, with a transverse section between 60 mm^2 (for example 20 mm x 3 mm) and 1400 mm^2 (for example 70 mm x 20 mm).

In the following description long metal product can be taken to mean any of the above products, and also any similar or comparable products, traveling up to more than 40-45 m/sec with an hourly production of 110 tonnes and more.

According to a first characteristic of the invention, the gripping device comprises pincer-type clamping means, able to be selectively activated, which are arranged in correspondence with the outer surface of said mandrel.

Advantageously the pincer means comprise four pincers, which rotate solidly with the mandrel, arranged at 90° one with respect to the other, and which are able to clamp the initial segment of the metal product.

The clamping steps are performed substantially as follows.

The leading end of the metal product enters into a device to distribute the spirals from which it is introduced, tangentially with respect to the mandrel, into a guide and containing device, or flap, which guides the leading end of the product by means of a groove.

This initial step of the winding, according to a variant, provides that the leading end of the product is conveyed by the flap inside a clamping zone.

According to a variant, said clamping zone comprises an annular containing channel, called rotary channel, made on a transverse plate arranged laterally to the mandrel. The annular channel can have a cylindrical shape, or preferably like a truncated cone; then in a section along a plane

passing through the axis of the mandrel, it has a shape respectively rectangular, square or preferably trapezoid or wedge-shaped.

According to one embodiment, the transverse plate can be completely external to the mandrel, or partly inside it.

The groove of the flap comprises a lateral wall which, at least in the flap that receives the leading end of the product, has an inclined or helical development, with an inclination sufficient to guide the leading end of the product towards the clamping zone. The groove with the inclined or helical wall can be limited to the upper flap, or to the lower flap, or can comprise at least part of both.

From the moment it arrives in correspondence with the clamping zone, the initial segment of the metal product cooperates with the clamping means. The clamping means, at least one in number, enter into action in a well-defined arc of the circumference of the mandrel, clamping the metal product onto the latter. The clamping means can grip in sequence or simultaneously, in order to firmly anchor the initial part of the metal product against the clamping zone. Simultaneous clamping occurs when a sufficient segment of the metal product has already wound around the clamping zone.

In the first winding step, that is, until the clamping means intervene, the high adherence of the metal product against the walls of the clamping zone is normally exploited. Generally this initial segment of the metal product has a length of between a little less than one and two spirals, according to the various factors connected to the structure of the coiling device and the material to be wound (shape, size, etc.).

When this stage wherein the pincer-type clamping means

are gripping is reached, it is possible to open the flaps and start immediately winding the rest of the metal product onto the mandrel.

According to another form of embodiment, on said containing element a flange is applied which is shaped so as to have an annular tooth substantially coaxial with the mandrel and which defines the annular clamping channel. In this way it is possible to obtain coils without protruding spirals. In fact, once the coil is complete, the lateral surface of the latter, on the clamping side, will be perfectly plane and parallel to the other lateral surface, with all the advantages deriving therefrom, even if the coil has a circular hollow corresponding to the bulk of the annular tooth. The circular hollow, however, will be almost negligible and in any case irrelevant if compared with the overall volume of the coil.

BRIEF DESCRIPTION OF THE DRAWINGS

Other purposes and advantages of the present invention will become apparent from the following description of a form of embodiment of a coiling device for long metal products, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 shows a coiling device with horizontal axis according to the present invention;
- fig. 2 shows in section a detail of the coiling device in fig. 1;
- fig. 3 shows a functioning diagram of the device in fig. 2;
- fig. 4 is a section view of a variant of the device according to the invention;
- fig. 4a shows an enlarged detail of fig. 4;
- fig. 5 is a section view of another variant of the device according to the invention.

DETAILED DESCRIPTION OF A PREFERENTIAL EMBODIMENT

With reference to the attached drawings, a coiling device "R" for metal products 10 is arranged downstream of a production line, not shown here. The metal product 10, in this case a wire, is guided towards a rotary reel 11 (fig. 1) thanks to a known distribution device not shown here, which distributes it in a desired and uniform manner.

The reel 11 comprises a mandrel 12 (fig. 2), with which an inner plate 13 is associated, arranged transverse and which defines one of the lateral walls 13a between which the coil is formed. The inner plate 13 has an annular channel 14, which in the section view appears like a throat, able to receive the initial segment of the metal wire 10.

In correspondence with the annular channel 14, the mandrel 12 has on its outer surface a zone 17 having improved adherence, having a sufficient extension. The zone 17 comprises, for example, an element with a high coefficient of friction.

The coiling device "R" also comprises two guide and containing elements, or flaps, of a known type, one upper 15 (fig. 1) and one lower 16, able to be driven by respective actuation mechanisms 18, 19, to be taken to, or distanced from, a specific working position.

The upper flap 15 (fig. 2) is provided with a grooved guide or groove 20, which provides a mouth, which guides the leading end of the metal wire 10 in the operation to wind the first spirals onto the mandrel 12, conveying the leading end inside the annular channel 14 of the inner plate 13.

According to a variant embodiment, the action to grip the metal wire 10 necessary to wind its first segment is achieved by exploiting the adherence of the metal wire 10

against the lateral wall of the inner plate 13, and the zone 17 with improved adherence, the whole being coordinated by the action of the flap 15 and/or 16.

According to the invention, along the outer circumference of the mandrel 12 there is at least a clamping pincer 21. In the diagram in fig. 3 four clamping pincers 21 are provided, respectively 21^{I}, 21^{II}, 21^{III}, 21^{IV}.

The number of clamping pincers 21 and their position depends on many factors and in any case the configuration that offers the best results must be chosen, also taking into account the mechanical equilibrium of the system.

According to an alternative variant, the clamping pincers 21 can cover all, or almost all, the circumference of the mandrel 12, creating a sort of "single continuous pincer", that is, a clamping ring.

The clamping pincers 21 are commanded by an actuation device.

The actuation device, according to the embodiment shown in fig. 2, provides a thrust ring 22, which acts on a bearing solid with a first arm 23 of each clamping pincer 21, rotating together with the mandrel 12. By moving the ring in the direction of the arrow 24, by means of an actuation device of a known type, not shown here, the clamping pincers 21 engage the metal wire by means of a second arm 25.

A second form of embodiment, or variant, is shown in figs. 4 and 4a.

In this second form of embodiment, a flange 30 is provided, applied for example on the inner containing plate 13 and shaped so as to have an annular tooth 31 substantially coaxial with the mandrel 12. The annular tooth 31 defines the annular channel 14 (fig. 4a).

The annular tooth 31 can advantageously be slightly

convergent towards the outside and advantageously has a thickness or height H substantially equal to the diameter of the rolled product 10, when the latter is of relatively large size, for example 16 mm or more, or equal to a multiple of the diameter of the rolled product 10 (as in the case shown in fig. 4a), when the latter is of relatively small size, for example 6 mm. In this second case the height H of the annular tooth 31 is for example 12 mm.

The protrusion or length L of the annular tooth 31 is substantially equal to a value of between 1.5 and 2 times the diameter of the rolled product 10.

The flange 30 can also be interchangeable according to the size of the rolled product 10 to be wound and is made in a material with great hardness, such as for example steel for tools.

Moreover, in this second form of embodiment, the clamping pincers 21 clamp the metal wire 10 by thrusting it radially against the upper inner wall of the annular channel 14. In this variant the clamping pincers 21 are driven by a system of rapid clamping and release, able to command them according to the desired sequence. For example, the system of rapid clamping and release comprises an actuator device 26 (fig. 4) acting on respective arms 27, which act on the clamping pincers 21.

A further form of embodiment is shown in fig. 5, wherein the clamping pincers 21 are driven directly by mechanical or hydraulic jacks, or other suitable type, which rotate together with the mandrel 12 and which exert a clamping pressure by pressing the metal wire 10 against a wall of the annular channel 14.

According to a variant to this further form of embodiment, the clamping pincers 21 thrust the metal wire

10 towards the axis of rotation and clamp it against the zone 17 with improved adherence.

The coiling device "R" according to the invention can also be used when the coiling machine has only one flap cooperating with the mandrel 12, or when it has more than two.

The coiling device "R" functions as follows during the clamping steps.

The leading end of the metal wire 10 is made to enter into the groove 20 of the upper flap 15. The groove 20 has means 28, inclined or helical, suitable to displace the metal wire 10 towards the zone 17 of improved adherence and towards the inner plate 13.

The leading end of the metal wire 10 is made to wind for a length sufficient to allow at least one clamping pincer 21 to be able to clamp it.

When the leading end of the metal wire 10 is firmly gripped by the clamping pincers 21, it is possible to open the flaps 15, 16 by means of the actuation devices 18, 19, and start distributing the metal wire 10 onto the mandrel 12.

The clamping pincers 21 are opened when the metal wire 10 has wound onto the mandrel 12 sufficiently so as to remain autonomously clamped, for example after the second layer of spirals has been deposited.

According to a variant, it is possible that the clamping pincers 21 remain gripping throughout the whole coiling process of the product, and are released when the formed coil is removed from the mandrel 12.

According to another variant, it is provided that, when the second layer of spirals is about to be completed, the clamping pincers 21 are opened and the inner plate 13 is displaced axially with respect to the mandrel 12, so that

the first layer of spirals is also aligned laterally with the following one.

With the coiling device "R" according to the invention rolls or bars of great compactness and weight are obtained: the filling coefficient varies from 0.6 to 0.9 while the weight of the coil varies from 1500 to 5000 kg. The typical sizes of the coil are: inner diameter of between 700 mm and 900 mm, height between 700 mm and 900 mm, outer diameter variable according to the inner diameter, the height, the weight and the filling coefficient of the coiled roll.

It is clear, however, that modifications and/or additions of parts may be made to the coiling device "R" as described heretofore, without departing from the field and scope of the present invention.

It is also clear that, although the present invention has been described with reference to some specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of coiling device and method for rolled or drawn products, all of which shall come within the field and scope of the present invention.